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ESTIMATES OF EFFORT AND HARVEST FOR SELECTED SPORT FISHERIES FOR CHINOOK SALMON IN NORTHERN COOK INLET, ALASKA, 1987[1]

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ABSTRACT

Creel surveys were conducted in selected sport fisheries for chinook salmon *Oncorhynchus tshawytscha* in northern Cook Inlet during 1987. Roving creel surveys were conducted at the sport fisheries in: Deshka River; Alexander Creek; and Lake Creek. Direct expansion creel surveys were conducted for the fisheries in: Clear Creek; Upper Susitna River; the weekend-only fisheries at Willow, Little Willow, Sheep, Goose, and Montana Creeks; and at the Little Susitna River. For all fisheries surveyed, the estimated total effort by anglers was 287,353 angler-hours. An estimated 17,690 chinook salmon were harvested (fish kept only) by anglers and 32,923 chinook salmon were caught (fish kept and fish released). The majority of the angler-effort (63 percent), chinook salmon harvest (64 percent), and chinook salmon catch (68 percent) occurred in the remote (accessible only by boat or plane) fisheries which are open 7 days a week. The weekend-only fisheries in Willow and Montana Creeks, however, had the second and third largest amount of angler-effort for hour the fishery was open and had the largest harvests of chinook salmon per hour the fishery was open. The 1.3 and 1.4 age groups were the most abundant ages in the sport harvests in all streams but the Little Susitna River. A total of 50,471 chinook salmon were counted in the escapements of tributaries to the Susitna River.

KEY WORDS: creel survey, northern Cook Inlet, chinook salmon, harvest, catch, effort, escapement counts, population age structure

INTRODUCTION

The sport fishery for chinook salmon *Oncorhynchus tshawytscha* in northern Cook Inlet is among the largest recreational fisheries in Alaska (Mills 1986). This fishery occurs in tributaries to the Susitna River and other smaller rivers which drain directly into northern Cook Inlet (Figure 1). The areas where the sport fishery occurs are categorized into four groups: (1) tributaries on the east side of the Susitna River that are accessible from the Parks Highway; (2) remote Susitna and Yentna River tributaries that are not road-accessible and primarily enter the mainstem of these rivers from the west and north; (3) the Little Susitna River; and (4) remote river systems that drain directly into northern Cook Inlet from the north and west[1].

During the 1960s and 1970s, the sport fishery for chinook salmon in northern Cook Inlet systems was periodically closed because of small chinook salmon escapements. The commercial fishery for chinook salmon returning to northern Cook Inlet systems was closed from 1963 to 1985. These closures helped increase the returns of chinook salmon to a level that resource managers felt could once again be exploited. The sport fishery for chinook salmon has been open every year since 1979 and a small commercial fishery for chinook salmon in northern Cook Inlet reopened in 1986.

Prior to 1986, only five streams along the Parks Highway were open to sport fishing for chinook salmon. Three of these streams (Willow, Montana, and Caswell Creeks) were open only during 4 weekends from late May through mid-June, while the Talkeetna and Little Susitna Rivers were open to continuous fishing from late May to early July. Effort in these fisheries increased from an estimated 47,500 angler-hours in 1979 to over 155,000 angler-hours in 1985 (Hepler and Bentz 1986). During this period, the estimated harvests of chinook salmon by these fisheries ranged from 1,650 fish in 1979 to nearly 4,900 fish in 1984 (Hepler and Bentz 1986). In 1986, five additional road-accessible streams (Little Willow, Sheep, Goose, Sunshine, and Birch Creeks) were opened to fishing during 4 weekends from late May through mid-June. In 1987, the entire Susitna River corridor between the mouth of the river and upstream to the confluence of the Talkeetna River was opened to sport fishing and the weekend fishing period on these streams was extended to include Mondays.

The number of remote streams open to chinook salmon fishing in the Susitna and Yentna River drainages and in western Cook Inlet has also increased since 1979. From 1979 to 1982, only the Deshka River and Lake and Alexander Creeks were open to chinook salmon fishing. In 1983, the open area was expanded to include the entire Chuitna and Yentna River drainages. In 1984, all coastal streams draining into western Cook Inlet north of the West Foreland and all tributaries on the west side of the Susitna River downstream of the Deshka River were added to the open area (Figure 1). These additional openings helped to increase angler-effort in the remote fisheries from an estimated 65,900 angler-hours in 1979 to 136,400 angler-hours in 1985 (Hepler and Bentz 1986). During the period 1979 through 1986, the estimated harvests of chinook salmon by these fisheries ranged from 3,166 fish in 1981 to 11,413 fish in

[1] The remote river systems were not surveyed in 1987.

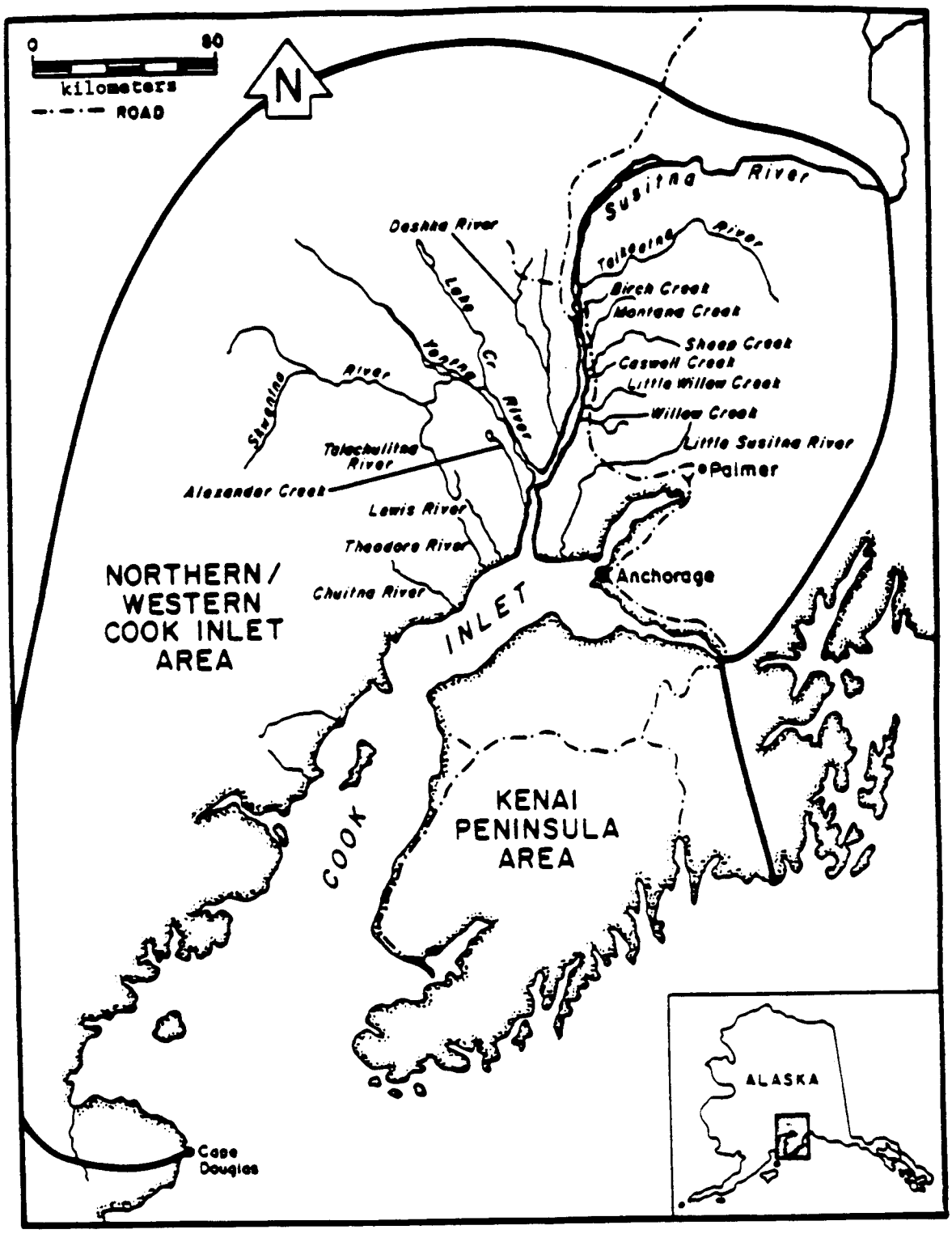

Figure 1. Map of the northern Cook Inlet area.

1985 (Hepler and Bentz 1986). In 1987, the upper Susitna River drainage above its confluence with the Talkeetna River was also opened to sport fishing and 1 additional week was added to the fishing season on the remote streams.

The objectives of this report are to present: (1) estimates of angler-effort for sport fisheries in selected roadside and remote streams in the Susitna River drainage and in the Little Susitna River; (2) estimates of the harvest (number of fish kept by anglers) and catch (number of fish kept plus those released by anglers) of chinook salmon; (3) estimates of the sex, age, and length compositions of harvested chinook salmon; and (4) estimates of the minimum escapement of chinook salmon to selected index streams in northern Cook Inlet.

Harvest and effort estimates for the years 1979 to 1986 are presented in Bentz (1982, 1983), Delaney and Hepler (1983), Hepler and Bentz (1984, 1985, 1986, 1987), Hepler and Kubik (1982), Kubik (1980, 1981), and Watsjold (1980, 1981).

METHODS

Creel Surveys

Roving and direct expansion creel surveys were used in this study. The sample design and methods of analysis for each are described below.

Roving Creel Surveys:

Roving creel surveys (Neuhold and Lu 1957) were conducted to estimate effort for and catch and harvest of chinook salmon by anglers on the Deshka River and Alexander and Lake Creeks. Brief descriptions of these systems follow:

Deshka River. Approximately 50 km (31 mi) of the Deshka River were open to fishing for chinook salmon from 1 January to 13 July. The open section was divided into two survey areas for the creel survey. The downstream area encompassed the lower 1.6 km (1.0 mi) of the river from its confluence with the Susitna River upstream to the Alaska Department of Fish and Game cabin. Primary access by anglers to the downstream area is by riverboats launched from Susitna Landing. The upstream area included the remaining open section from the cabin upstream to the confluence of Moose and Kroto creeks. Primary access by anglers to this area is by riverboats that travel upstream from the mouth, floatplanes that land on nearby lakes, and float trips that originate from Petersville Road.

Alexander Creek. The entire Alexander Creek drainage was open to fishing for chinook salmon from 1 January to 13 July. The open section was divided into two survey areas. The downstream area encompassed the lower 1.6 km (1.0 mi) from the creek's confluence with the Susitna River upstream to Gabbert's Fish Camp and the upstream area encompassed the remaining open section from Gabbert's Fish Camp upstream to Alexander Lake. Primary access by anglers to the downstream area is by riverboats, wheel planes, and floatplanes and to the upper area by float trips that originate from Alexander Lake and riverboats that travel upstream from the creek's mouth.

Lake Creek. The entire drainage of Lake Creek was open to fishing for chinook salmon from 1 January to 13 July. Physical barriers within the river, however, restricted the majority of the anglers to the lower 3.2 km (2.0 mi) of the river. The survey area only included the lower 3.2 km of the stream. Primary access by anglers to this fishery is by floatplanes and riverboats.

A stratified random sample design was used for angler counts on the downstream areas of the Deshka River and Alexander Creek and on Lake Creek. Days were stratified into either three (downstream Deshka River and Alexander Creek) or five (Lake Creek) sample periods. Effort was estimated separately for weekdays and for weekends/holidays on each week the fishery was surveyed. Within each period (A, B, etc.), 3 days were randomly selected without replacement for conducting angler counts during weekdays. An angler count was conducted in each period on each weekend/holiday day.

Counts of anglers were conducted from a fixed-wing aircraft on the upstream areas of the Deshka River and Alexander Creek. Because of the expense of these surveys only five counts were conducted each week, three on randomly selected (without replacement) weekdays and one on each weekend/holiday day. A simple random sample design was used. The angler day was stratified into three 6-hour sample periods to ensure the distribution of sampling effort over the defined angler-day.

Details for the creel survey at each location were as follows:

Deshka River - downstream.

1. Dates: 23 May to 2 July.
2. Fishing day: 18 hours, 0500 through 2300.
3. Daily periods: three 6-hour sample periods (A, B, and C).
4. Sample unit length: 2 hours.
5. Other: Survey clerks only interviewed anglers who indicated they would not exit this fishery through the boat launch at Susitna Landing or Willow Creek.

Deshka River - upstream.

1. Dates: 23 May to 12 July.
2. Fishing day: 18 hours, 0500 through 2300.
3. Daily periods: three 6-hour sample periods (A, B, and C).
4. Other: Catch rate and harvest rate data for this location were collected from anglers exiting the fishery at Susitna Landing (refer to the direct expansion methods for a description of this location).

Alexander Creek - downstream.

1. Dates: 23 May to 14 June.
2. Fishing day: 18 hours, 0500 through 2300.
3. Daily periods: three 6-hour sample periods (A, B, and C).
4. Sample unit length: 2 hours.

Alexander Creek - upstream.

1. Dates: 8 June to 12 July.
2. Fishing day: 18 hours, 0500 through 2300.
3. Daily periods: three 6-hour sample periods (A, B, and C).
4. Other: Catch rate and harvest rate data for this location were collected from anglers exiting the fishery through the downstream area of Alexander Creek.

Lake Creek.

1. Dates: 6 June to 12 July.
2. Fishing Day: 20 hours, 0500 through 0100 (next day).
3. Daily periods: five 4-hour sample periods (A, B, C, D, and E).
4. Sample unit length: 2 hours during weekends/holiday and 4 hours during weekdays.

Within a period selected for sampling, a starting time was randomly selected to conduct an angler count from the whole hours in the period (e.g., 0500, 0600). Anglers were counted while driving a riverboat the length of the survey area on Lake Creek and in the downstream survey areas of the Deshka River and Alexander Creek. It took approximately 15 minutes to conduct an angler count in these areas. Anglers were counted from a fixed-wing aircraft on the upstream areas of the Deshka River and Alexander Creek. A coin was tossed to determine the starting point (upstream or downstream) for beginning the angler count at the start of a selected count time. Angler counts were considered instantaneous events (Neuhold and Lu 1957).

Angler interviews were conducted during the time in a sample unit not used for the angler count. Interviews were conducted throughout the length of the survey area on Lake Creek and the downstream areas of the Deshka River and Alexander Creek. Survey clerks recorded the following information from each angler interviewed:

1. The number of hours spent fishing.
2. The number and species of fish harvested.
3. The number and species of fish released.
4. Whether the angler had completed the fishing trip or not.
5. Whether or not the angler had been interviewed previously during the same day.
6. Whether or not the angler was using a professional guide.
7. Whether the angler used guided, chartered, or private transportation to reach the fishery.
8. For boat anglers, whether the boat was an inboard, airboat, raft, or outboard. Additionally, if an outboard was used, which of the following categories it fell into: 2-49 horse power (hp), 50-80 hp, or greater than 80 hp.

For the downstream Deshka River, downstream Alexander Creek, and Lake Creek surveys, angler effort and its variance were estimated separately for the

weekdays and weekend/holiday components of each week. Effort was estimated as follows (Scheaffer et al. 1979):

$$\hat{E} = \sum_{j=1}^{P} \bar{x}_j H_j \qquad [1]$$

Definitions of the notation for the roving creel surveys are presented in Table 1. The variance of $\hat{E}_j$ was estimated by (Scheaffer et al. 1979):

$$V(\hat{E}) = \sum_{j=1}^{P} [H_j^2 (s_j^2/n_j)] \qquad [2]$$

For the surveys of the upstream areas of the Deshka River and Alexander Creek, effort and its variance were estimated for each week as:

$$\hat{E} = \bar{x}H \qquad [3]$$

and variance of $\hat{E}$ by:

$$V(\hat{E}) = H^2 (s^2/n) \qquad [4]$$

Total effort for each fishery was estimated by summing all the weekday and weekend/holiday estimates. Since these are considered independent estimates, the estimated variance of the total was the sum of the variances.

Rates of catch (fish kept plus those released) and harvest (fish kept only) of chinook salmon were estimated using a two-stage sample design with a finite number of primary sampling units (days) and an unknown number of secondary units (anglers). Only completed-trip interviews were used to estimate catch and harvest rates on the Deshka River and Alexander and Lake Creeks. Catch rates were estimated for each sampled day and for each weekday and weekend/holiday component. Catch per unit of effort (CPUE) was estimated for each of the weekday and weekend/holiday components of the fishery as:

$$\text{CPUE} = \bar{c}/\bar{f} = \left[\sum_{i=1}^{D} \sum_{k=1}^{m_i} c_{ik}\right] / \left[\sum_{i=1}^{D} \sum_{k=1}^{m_i} f_{ik}\right] \qquad [5]$$

The variance of CPUE was approximated using the formula for the quotient of the mean of two random variables (Jessen 1978), which is:

$$V(\text{CPUE}) \approx [\bar{c}/\bar{f}]^2 [s_c^2/\bar{c}^2 + s_f^2/\bar{f}^2 - (2rs_c s_f/\overline{cf})] \qquad [6]$$

Table 1. Definitions for the notation used in the equations for the roving creel surveys.

Notation	Definition
$\hat{C}$	the estimate of catch[1] during a specific weekday or weekend/holiday component of a fishery.
$\bar{c}$	the mean catch[1] per angler by all anglers interviewed during a specific weekday or weekend/holiday component of a fishery.
$\bar{c}_i$	the mean catch[1] per angler by all anglers interviewed on day *i* during a specific weekday or weekend/holiday component of a fishery.
c_{ik}	the catch[1] by angler *k* interviewed on day *i* during a specific weekday or weekend/holiday component of a fishery.
D	the number of days the fishery was open during a specific weekday or weekend/holiday component of a fishery.
d	the number of days on which angler interviews were conducted during a specific weekday or weekend/holiday component of a fishery.
$\hat{E}$	the estimate of effort in angler-hours for a specific weekday or weekend/holiday component of a fishery.
$\bar{f}$	the mean number of hours fished by all anglers interviewed during a specific weekday or weekend/holiday component of a fishery.
f_{ik}	the number of hours spent fishing by angler *k* interviewed on day *i* during a specific weekday or weekend/holiday component of a fishery.
H	the number of hours of possible fishing time during a specific weekday or weekend/holiday component of a fishery.
H_j	the number of hours of possible fishing time during period *j* of a specific weekday or weekend/holiday component of a fishery.
m_i	the number of anglers interviewed on day *i* during a specific weekday or weekend/holiday component of a fishery.
n	the number of angler counts conducted during a specific weekday or weekend/holiday component of a fishery.
n_j	the number of angler counts conducted during period *j* of a specific weekday or weekend/holiday component of a fishery.

-continued-

Table 1. Definitions for the notation used in the equations for the roving creel surveys (continued).

Notation	Definition
p	the number of daily time periods (A, B, C, etc.) in a specific weekday or weekend/holiday component of a fishery.
r	the correlation between the c_{ik} and f_{ik} for anglers interviewed during a specific weekday or weekend/holiday component of a fishery.
s^2	the sample variance for the mean angler count during a specific weekday or weekend/holiday component of a fishery ($\bar{x}$).
s_c^2	the two-stage estimate of variance for the mean catch by anglers interviewed during a specific weekday or weekend/holiday component of a fishery ($\bar{c}$).
s_f^2	the two-stage estimate of variance for the mean effort by anglers interviewed during a specific weekday or weekend/holiday component of a fishery ($\bar{f}$).
s_i^2	the sample variance for the mean catch by anglers interviewed on day i of a specific weekday or weekend/holiday component of a fishery ($\bar{c}_i$).
s_j^2	the sample variance for the mean angler count during period j of a specific weekday or weekend/holiday component of a fishery ($\bar{x}_j$).
$\bar{x}$	the mean angler count for a specific weekday or weekend/holiday component of a fishery.
$\bar{x}_j$	the mean angler count for period j during a specific weekday or weekend/holiday component of a fishery.

[1] Catch refers to either the catch of a single species (fish kept plus those released) or to harvest of a single species (fish kept) depending on the quantity being estimated.

The two-stage variance estimate for $\bar{c}$ was (Sukhatme et al. 1984, Von Geldern and Tomlinson 1973):

$$s_c^2 = [1-(d/D)]s_B^2/d + [\sum_{i=1}^{D}(s_i^2/m_i)]/(dD) \quad [7]$$

where:

$$s_B^2 = [\sum_{i=1}^{D}(\bar{c}_i-\bar{c})]^2/(d-1) \quad [8]$$

The variance for $\bar{f}$ was estimated identically as for $\bar{c}$ by substituting the necessary quantities for effort into equations 7 and 8.

Total catch for any weekday or weekend/holiday component was estimated as:

$$\hat{C} = \hat{E}\ CPUE \quad [9]$$

The variance of this estimate was calculated using the formula for the product of two independent random variables (Goodman 1960):

$$V(\hat{C}) = [\hat{E}^2\ V(CPUE)] + [CPUE^2\ V(\hat{E})] - [V(\hat{E})\ V(CPUE)] \quad [10]$$

Mean harvest rates and total harvest, and associated variances, were estimated for each weekday and weekend/holiday component following the above procedures with the exception that fish harvested by interviewed anglers were used.

The total catch and harvest for each fishery was estimated by summing the estimates for all the weekday and weekend/holiday components. Since these are considered independent estimates, the estimated variance of the total was the sum of the variances.

Several necessary assumptions are:

1. Angler counts made during the same day and on consecutive days are independent.
2. Interviewed anglers are representative of the total angler population.
3. The number of anglers interviewed during any day is proportional to the effort on that day.
4. No significant fishing effort occurs during the hours 2300-0500 on Alexander Creek and the Deshka River and during the hours 0100-0500 on Lake Creek.

The harvest of chinook salmon per angler-hour (HPUE) by anglers interviewed at the survey location in the downstream area of the Deshka River was compared to

the HPUE by Deshka River anglers who exited the downstream fishery at the Susitna Landing survey location. Anglers interviewed at the survey location in the downstream area of the Deshka River were not interviewed again at the Susitna Landing survey location so the two data sets were considered independent. To test whether the two sets of interview data could be pooled, a sign test (Conover 1980) was performed on the differences between the daily HPUE of chinook salmon at each location by treating the two estimates of HPUE as paired samples. Only days when five or more anglers were interviewed at each location were included in the analysis. The hypothesis tested can be stated as: the probability of HPUE estimated from the Susitna Landing interviews being larger than HPUE for the Deshka River interviews on any given day is the same as the probability of it being smaller. The sign test was selected because the values of HPUE were small and no assumption about the distribution of the data were necessary for the test.

Appropriate catch rate and harvest rate data collected from anglers at the Susitna Landing survey location were used to estimate catch and harvest by the fishery in the upstream area of the Deshka River.

Direct Expansion Creel Surveys:

Direct expansion creel surveys were used on the upper Susitna River; Clear, Willow, Little Willow, Sheep, Goose, and Montana Creeks; and the Little Susitna River. Brief descriptions of these systems follow:

Talkeetna River (Clear Creek). The Talkeetna River, which enters from the east at kilometer 157.8 (mile 98.0), is a major tributary to the Susitna River. The entire Talkeetna River drainage is open to chinook salmon fishing, however, due to the high turbidity in the mainstem of the Talkeetna River and rapids which are not passable by boat at approximately kilometer 29.0 (mile 18.0), fishing effort is concentrated at kilometer 8.1 (mile 5.0) near the mouth of Clear (Chunilna) Creek. Clear Creek was open to chinook salmon fishing for 3.2 km (2.0 mi) upstream from the creek's mouth from 1 January to 13 July. This fishery was accessible only by riverboat. Angler interviews for this fishery were collected at the boat landing in Talkeetna.

Upper Susitna River. Approximately 80 km (50 mi) of the upper Susitna River, including all tributaries such as Indian River and Portage and Fourth of July Creeks, were open to fishing for chinook salmon from 1 January to 13 July. Primary access by anglers to this area is by riverboats launched at Talkeetna and float trips that originate at the Gold Creek railroad bridge. Angler interviews for this area were collected at the boat landing in Talkeetna.

Willow Creek. The section open to fishing for chinook salmon in Willow Creek included all waters within a 0.4 km (0.25 mi) radius of the creek's confluence with the Susitna River and upstream to the Parks Highway. This section was open to fishing for chinook salmon on 4 consecutive weekends (from 0001 Saturday to 2400 Monday) from 13 June to 6 July. Generally, salmon hold in the confluence area and migrate upstream to the area near the Parks Highway bridge in early July. Because the stream is accessible from the road, primary access by anglers to the fishery is by vehicle and foot. Anglers normally fish within 0.8 km (0.5 mi) of the bridge area. Three access locations were

surveyed: (1) the Parks Highway bridge, where anglers either reach the river from the road and fish near the bridge or use the private boat launch near the bridge; (2) Susitna Landing, where anglers reach Willow Creek using boats launched at the Landing; and (3) the head of the trail that leads to the mouth of Willow Creek, where anglers reach the stream by foot and fish in the vicinity of the creek's confluence with the Susitna River.

Little Willow Creek. The section open to fishing for chinook salmon in Little Willow Creek included all waters within a 0.4 km (0.25 mi) radius of the creek's confluence with the Susitna River and upstream to the Parks Highway. This section was open to fishing for chinook salmon on 4 consecutive weekends (0001 Saturday to 2400 Monday) from 13 June to 6 July. Similar to Willow Creek, salmon hold in the confluence area and migrate upstream to the area near the Parks Highway bridge in early July. Because the stream is accessible from the road, most anglers reach the fishing area by vehicle and foot. Anglers normally fish within 0.8 km (0.5 mi) of the bridge area. Three access locations were surveyed: (1) the Parks Highway bridge, where anglers reach the river from the road and fish near the bridge; (2) Susitna Landing, where anglers reach Little Willow Creek using boats launched at the Landing; and (3) Willow Creek boat landing, where anglers reach Little Willow Creek using boats launched at the landing.

Sheep, Goose, and Montana Creeks. These streams were open to chinook salmon fishing on 4 consecutive weekends (from 0001 Saturday to 2400 Monday) from 13 June to 6 July within a 0.4 km (0.25 mi) radius of their confluence with the Susitna River and upstream to the Parks Highway bridges. The length of stream which is open to fishing varies with the morphology of the stream and ranges from approximately 0.8 to 13.0 km (0.5 to 8.0 mi). These streams are accessible from the Parks Highway, foot trails from the Parks Highway to the open fishing areas, and by riverboat. The streams were surveyed at their Parks Highway access sites.

Little Susitna River. Approximately 113 km (70 mi) of the Little Susitna River were open to fishing for chinook salmon from 1 January to 6 July. The creel survey was conducted at the two major access sites to the open section of the river. The lower river site, referred to as the Burma Road survey location, is located 45 km (28 mi) above the river mouth. Most anglers reach this site from a gravel road that branches off the Knik-Goose Bay Road. The upper river site, referred to as the Miller's Landing survey location, is located at the Parks Highway bridge which is the upper limit of the open section for chinook salmon fishing.

A stratified random sample design was used for the direct expansion creel surveys. The angler day was stratified into either two, three, or four sample periods. Effort was estimated separately for the weekday and weekend/holiday components of each week the fishery was surveyed. Within each period (A, B, etc.), 3 days were randomly selected without replacement for sampling during the weekdays. Each period was sampled on each weekend/holiday day for all the survey locations except Goose and Little Willow creeks; only two of the four daily periods were sampled at these locations.

Details for the creel survey at each location were as follows:

Talkeetna Boat Landing (Clear Creek and Upper Susitna River).

The Talkeetna boat landing is the primary boat launch used by recreational boaters in the Susitna River north of Talkeetna and Talkeetna River drainages. The landing is located in the village of Talkeetna on the Talkeetna River near its confluence with the Susitna River.

1. Dates: 13 June to 13 July.
2. Fishing day: 16 hours, 0800 through 2400.
3. Daily periods: two 8-hour sample periods (A and B).
4. Sample unit length: 3.5 hours.

Willow (mouth and bridge), Sheep, and Montana creeks.

1. Dates: 13 June (Sheep Creek) and 20 June (Willow and Montana Creeks) to 6 July; weekends (Saturday, Sunday, and Monday) only.
2. Fishing day: 24 hours, 0000 through 2400.
3. Daily periods: 6 hours for A and C and 12 hours for B.
4. Sample unit length: 3 hours for A and C, 4 hours for B on Montana and Sheep Creeks and 3 hours for A and C, 6 hours for C on Willow Creek.

Little Willow and Goose creeks.

1. Dates: 27 June to 6 July.
2. Fishing day: 24 hours, 0000 through 2400.
3. Daily periods: four 6-hour sample periods (A, B, C, and D).
4. Sample unit length: 3 hours.

Susitna Landing (Willow and Little Willow creeks):

Susitna Landing is the primary boat launch used by recreational boaters for the Susitna River drainage below the Parks Highway bridge. The landing is located on the Kashwitna River near its confluence with the Susitna River.

1. Dates: 13 June to 6 July.
2. Fishing day: 18 hours, 0500 through 2300.
3. Daily periods: three 6-hour sample periods (A, B, and C).
4. Sample unit length: 3 hours.

Little Susitna River (Burma Road).

1. Dates: 1 June to 6 July.
2. Fishing day: 20 hours, 0400 through 2400.
3. Daily periods: four 5-hour sample periods (A, B, C, and D).
4. Sample unit length: 3 hours.

Little Susitna River (Miller's Landing).

1. Dates: 15 June to 6 July.
2. Fishing day: 16 hours, 0800 through 2400.
3. Daily periods: two 8-hour sample periods (A and B).
4. Sample unit length: 3.5 hours.

Within a period selected for sampling, a time to begin sampling was randomly selected from those whole hours in the period (0500, 0600, etc.) which allowed the entire sample unit to fall within the defined period. A creel survey clerk was stationed at an access site to a fishery during a selected sample period. All anglers departing the fishery through the access site during the sample period were contacted by the survey clerk. Survey clerks recorded the same information from each interviewed angler as previously described for the roving creel surveys. If the survey clerk was unable to contact all anglers (usually due to large numbers of anglers leaving the fishery at the same time), a count of all anglers who were not interviewed was kept.

We are not aware of any previous documentation of methods for estimating effort, catch, and harvest in direct expansion creel surveys that include estimates of variance for these quantities. Therefore, a detailed description of our methods and the rationale behind them will be presented. Definitions of the notation used to describe the direct expansion surveys are presented in Table 2.

The estimation of angler effort by a direct expansion creel survey can be considered as a problem in estimating a rate. Effort was estimated in units of angler-hours. The rate estimated was the number of angler-hours leaving an access site during each hour the fishery was in progress. The product of this rate and the total number of possible fishing hours in the fishery was an estimate of angler effort. This was expressed as:

$$\hat{E} = \sum_{j=1}^{p} H_j \ (\bar{e}_j/\bar{h}_j) \qquad [11]$$

The variance of effort was estimated as:

$$\hat{V}(E) = \sum_{j=1}^{p} H_j^2 \ V(\bar{e}_j/\bar{h}_j) \qquad [12]$$

The variance of the rate, $\bar{e}_j/\bar{h}_j$, was approximated by the variance for the quotient of two random variables (Jessen 1978):

$$V(\bar{e}_j/\bar{h}_j) \approx (\bar{e}_j/\bar{h}_j)^2 (1/d_j)(s_e^2/\bar{e}_j^2 + s_h^2/\bar{h}_j^2 - 2rs_e s_h/\bar{e}_j\bar{h}_j)(1 - h_j/H_j) \qquad [13]$$

In most of the fisheries surveyed, the time spent surveying on day i of period j (h_{ij}) was relatively constant on each sampling occasion. In some instances,

Table 2. Definitions for the notation used in the equations for the direct expansion creel surveys.

Notation	Definition
D	the number of days the fishery was open during a specific weekday or weekend/holiday component of a fishery[1].
d_j	the number of days censused during period j of a specific weekday or weekend/holiday component of a fishery[1].
$\hat{E}$	the estimate of effort in angler-hours[2] for a specific weekday or weekend/holiday component of a fishery[1].
$\bar{e}_j$	the mean number of angler-hours[2] leaving a census site during a sample unit in period j of a specific weekday or weekend/holiday component of a fishery[1].
e_{ij}	the number of angler-hours[2] leaving a census site during period j on day i of a specific weekday or weekend/holiday component of a fishery[1].
$\bar{f}_{ij}$	the mean number of hours fished by anglers censused during period j on day i of a specific weekday or weekend/holiday component of a fishery[1].
H_j	the number of hours of possible fishing time during period j of a specific weekday or weekend/holiday component of a fishery[1].
$\bar{h}_j$	the mean number of hours censused on days sampled during period j of a specific weekday or weekend/holiday component of a fishery[1].
h_j	the number of hours censused during period j of a specific weekday or weekend/holiday component of a fishery[1].
h_{ij}	the number of hours censused during period j on day i of a specific weekday or weekend/holiday component of a fishery[1].
M_{ij}	the number of completed-trip anglers leaving the fishery during period j of day i during a specific weekday or weekend/holiday component of a fishery[1].
m_{ij}	the number of completed-trip anglers leaving the fishery who are interviewed during period j of day i during a specific weekday or weekend/holiday component of a fishery[1].
p	the number of daily time periods (A, B, C, etc.) in a specific weekday or weekend/holiday component of a fishery[1].

-continued-

Table 2. Definitions for the notation used in the equations for the direct expansion creel surveys (continued).

Notation	Definition
r	the correlation between the e_{ij} and h_{ij} for sample units collected during a specific weekday or weekend/holiday component of a fishery[1].
s_e^2	the sample variance for the mean number of angler-hours leaving a census site on a sample day during a period of a specific weekday or weekend/holiday component of a fishery[1] ($\bar{e}_j$).
s_{eij}^2	the estimated sample variance for the mean number of angler-hours leaving a census site during period j on day i of a specific weekday or weekend/holiday component of a fishery[1] ($\bar{e}_{ij}$).
s_{fij}^2	the sample variance for the mean effort by anglers departing a fishery during period j on day i of a specific weekday or weekend/holiday component of a fishery[1] ($\bar{f}_{ij}$).
s_h^2	the sample variance for the mean number of hours censused on a sample day during a period of a specific weekday or weekend/holiday component of a fishery[1] ($\bar{h}_j$).

[1] Fishery refers to an access site that is censused to estimate effort and catch for a particular fishery.

[2] All angler-hours referred to are for completed-trip anglers.

however, h_{ij} varied considerably during the fishery due to logistical problems and the h_{ij} were considered random variables. This variation is represented by the variance of the sample unit length in Equation 13 (s_h^2). The coefficient of variation was used to determine if the h_{ij} were treated as random variables. If the coefficient of variation exceeded 20%, the h_{ij} were treated as random variables, otherwise the h_{ij} were treated as constant.

For h_{ij}^2 constant, s_h equals zero and the variance of the estimate of angler effort simplifies to:

$$V(\hat{E}) = \sum_{j=1}^{P} d_j \, (H_j/h_j)^2 \, s_e^2 \, (1 - h_j/H_j) \qquad [14]$$

When it was not possible to interview all anglers leaving the access site, the effort by the anglers who were not interviewed was estimated. In contrast to the previous situation, where the effort leaving the fishery during period j on day i (e_{ij}) was considered to be measured without error, error is now associated with e_{ij}. Effort leaving the fishery during a given sample unit was estimated for period j on day i by:

$$\hat{e}_{ij} = M_{ij} \, \bar{f}_{ij} \qquad [15]$$

and

$$V(\hat{e}_{ij}) = M_{ij}^2 \, (s_{fij}^2/m_{ij}) \, (1 - m_{ij}/M_{ij}) \qquad [16]$$

Effort for period j was estimated by:

$$\hat{E}_j = H_j \, (\hat{e}_j/h_j) \qquad [17]$$

The variance of $\hat{E}_j$ was estimated using equations 12 and 13 with the exception that the variance of the mean number of angler-hours of effort by completed-trip anglers censused during each sampling event now has two components, the within-day variance due to missed anglers and the between-day variance. Letting

$$\hat{s}_e^2 = s_{Be}^2 + h_j/[d_j(H_j - h_j)] \sum_{i=1}^{D} \hat{s}_{eij}^2 \qquad [18]$$

estimate the variance of $\hat{e}_j$ with the between-day variance (s_{Be}^2) equal to:

$$s^2_{Be} = [\sum_{i=1}^{D}(e_{ij} - \bar{e}_j)^2]/(d_j - 1), \quad [19]$$

the variance of $\hat{E}_j$ was estimated by substituting $\hat{s}^2_e$ for s^2_e in equation 13 (Sukhatme et al. 1984).

By replacing s^2_e with $\hat{s}^2_e$, the variance of the angler effort estimate simplifies to equation 14 when the h_j are constant.

The catch and harvest of a species, and their variances, were estimated with the same procedures used to estimate effort by simply substituting the corresponding quantities for catch or harvest in place of effort.

Assumptions necessary for the direct expansion creel survey design are:

1. No significant fishing effort occurs during the hours not included in the fishing day.
2. All anglers participating in a particular fishery exit the fishery through a surveyed access site.
3. All anglers who are not interviewed are counted and all non-interviewed anglers are completed-trip anglers.

Biological Data:

At each fishery, the chinook salmon harvested by the sport fishery were randomly sampled for age, sex, and length. Three scales were collected on the left side of each fish approximately two rows above the lateral line and on the diagonal row downward from the posterior insertion of the dorsal fin as described in Clutter and Whitesel (1956). Scales were mounted on adhesive-coated cards and impressions were made in cellulose acetate. Age determinations were made by examination of scales using a microfiche reader. Ages were designated using the European method (Koo 1962) where the first number refers to the number of years of freshwater residence after emergence and the second number refers to the number of years of marine residence. Fish lengths were measured from the middle of the eye to fork of the tail to the nearest 0.5 cm.

The proportional age composition of the sampled portion of the sport harvest was estimated for each fishery. Letting $\hat{p}_h$ equal the estimated proportion of age group h in the sample, the variance of $\hat{p}_h$ was estimated using the normal approximation to the binomial (Scheaffer et al. 1979):

$$V(\hat{p}_h) = \hat{p}_h(1-\hat{p}_h)/(n_T-1), \quad [20]$$

where n_T is the total number of legible scales collected from chinook salmon during the fishery.

Mean length at age by sex and its variance were estimated using standard normal procedures.

Escapement Counts

Chinook salmon spawning in established index streams within the study area were counted during aerial and foot surveys. Ease of access determined the survey type for each index stream. Surveys were conducted during the peak spawning period which was identified through frequent inspections of spawning activity in index streams which are easily accessible. Escapement data reported are the maximum number of fish, both live and dead, observed during a single survey. No attempt has been made to account for fish not observed due to poor visibility, migrational timing, or decay. Additional escapement data were collected from a weir located on Deception Creek.

RESULTS

Remote Streams

The remote streams are those which anglers can reach only by boat or plane. In 1987, creel surveys were conducted in the following remote streams: Deshka River, both downstream and upstream sections; Alexander Creek, both downstream and upstream sections; Lake Creek; Clear Creek in the Talkeetna River; and the Upper Susitna River. Angler count creel surveys were used at all locations except for Clear Creek and the Upper Susitna River where direct expansion creel surveys were used. The fisheries in these streams are open 7 days a week.

Deshka River:

The creel survey of the Deshka River was conducted from 23 May through 2 July in the downstream section and 23 May through 12 July in the upstream section of the river.

Effort. Anglers counts ranged from 2 to 251 in the downstream section and from 0 to 133 in the upstream section (Appendix Table 1). Estimated angler-effort during the survey was 71,687 angler-hours, 43,127 angler-hours (60%) in the downstream section and 28,560 angler-hours (40%) in the upstream section (Table 3). The distribution of fishing effort between the weekday and weekend/holiday components was about equal in both sections of the river; 41% of the downstream effort and 42% of the upstream effort occurred during the weekend/holiday component.

Harvest Rates and Catch Rates. The sign test comparing the daily values of harvest per hour of chinook salmon in the downstream section estimated using interviews from anglers exiting the fishery at Susitna Landing to the daily HPUE values using interviews of anglers not exiting the fishery through Susitna Landing (Appendix Table 2) was not significant ($P > 0.10$) and the two groups of interviews were pooled. Daily harvest rates of chinook salmon ranged from 0.000 to 0.300 fish per hour (Appendix Table 3) in the downstream

Table 3. Estimated number of angler-hours of effort during each of the weekday and weekend/holiday components of the fishery for chinook salmon in the Deshka River, 1987.

Location Component[1]		Effort	Standard Error	95% Confidence Interval	Relative Precision[2]
Downstream					
WE	5/23-5/25	2,820.0	505.6	1,829 - 3,811	35.1%
WE	5/30-5/31	2,964.0	446.4	2,089 - 3,839	29.5%
WE	6/06-6/07	4,134.0	593.9	2,970 - 5,298	28.2%
WE	6/13-6/14	5,166.0	693.5	3,807 - 6,525	26.3%
WE	6/20-6/21	2,082.0	437.7	1,224 - 2,940	41.2%
WE	6/27-6/28	660.0	126.7	412 - 908	37.6%
	Sub-total	17,826.0	1,223.2	15,429 - 20,223	13.4%
WD	5/26-5/29	2,296.0	376.3	1,558 - 3,034	32.1%
WD	6/01-6/05	4,380.0	593.8	3,216 - 5,544	26.6%
WD	6/08-6/12	8,047.5	853.3	6,375 - 9,720	20.8%
WD	6/15-6/19	6,695.0	396.7	5,917 - 7,473	11.6%
WD	6/22-6/26	3,090.0	433.7	2,240 - 3,940	27.5%
WD	6/29-7/02	792.0	142.7	512 - 1,072	35.3%
	Sub-total	25,300.5	1,260.2	22,831 - 27,771	9.8%
TOTAL		43,126.5	1,756.2	39,684 - 46,569	8.0%
Upstream					
WE	5/23-5/25, 5/30-5/31[3]	540.0	211.1	126 - 954	76.6%
WE	6/06-6/07, 6/13-6/14[3]	7,182.0	991.7	5,238 - 9,126	27.1%
WE	6/20-6/21, 6/27-6/28[3]	2,916.0	1,045.2	867 - 4,965	70.3%
WE	7/03-7/05, 7/11-7/12[3]	1,404.0	461.2	500 - 2,308	64.4%
	Sub-total	12,042.0	1,527.5	9,048 - 15,036	24.9%
WD	5/26-5/29	576.0	72.0	435 - 717	24.5%
WD	6/01-6/05	1,140.0	649.7	0 - 2,413	111.7%
WD	6/08-6/12	4,680.0	749.4	3,211 - 6,149	31.4%
WD	6/15-6/19	5,550.0	608.9	4,357 - 6,743	21.5%
WD	6/22-6/26	3,210.0	1,067.9	1,117 - 5,303	65.2%
WD	6/29-7/02	792.0	313.8	177 - 1,407	77.7%
WD	7/06-7/10	570.0	346.0	0 - 1,248	119.0%
	Sub-total	16,518.0	1,648.7	13,287 - 19,749	19.6%
TOTAL		28,560.0	2,247.6	24,155 - 32,965	15.4%
GRAND TOTAL		71,686.5	2,852.3	66,096 - 77,278	7.8%

[1] WE = weekend/holiday; WD = weekday.

[2] Relative precision of 95% confidence interval.

[3] Components were combined because of small sample sizes.

section of the Deshka River and from 0.000 to 0.250 fish per hour in the upstream section (Appendix Table 4). The weekend/holiday component from 27 to 28 June had the highest chinook salmon harvest rate, 0.113 fish per hour, of all components in the downstream section and the weekday components from 15 to 19 June and 22 to 26 June had the highest chinook salmon harvest rates, 0.102 fish per hour, of all components in the upstream section (Table 4). Catch rates of chinook salmon peaked from 15 to 19 June in the downstream section and from 27 to 28 June in the upstream section (Figure 2).

Harvest and Catch. The estimated harvest of chinook salmon in the Deshka River during the creel survey was 4,870 fish; 2,924 chinook salmon (60%) were harvested in the downstream section and 1,946 chinook salmon (40%) were harvested in the upstream section (Table 5). In the downstream section, 38% of the chinook salmon caught by anglers were released and, in the upstream section, 23% of the chinook salmon caught were released.

Alexander Creek:

The creel survey of Alexander Creek was conducted from 23 May through 14 June in the downstream section and from 8 June through 12 July in the upstream section.

Effort. Anglers counts ranged from 2 to 73 in the downstream section and from 0 to 81 in the upstream section (Appendix Table 5). Estimated effort during the survey was 27,067 angler-hours, 9,595 angler-hours (35%) in the downstream section and 17,472 angler-hours (65%) in the upstream section (Table 6). In the downstream section of the river, 46% of the angler-effort occurred during the weekend/holiday component but in the upstream section only 28% of the effort occurred during this component.

Harvest Rates and Catch Rates. Daily harvest rates of chinook salmon ranged from 0.000 to 0.593 fish per hour (Appendix Table 6) in the downstream section of Alexander Creek and from 0.000 to 0.143 fish per hour in the upstream section (Appendix Table 7). The weekday component from 1 to 5 June had the highest chinook salmon harvest rate, 0.096 fish per hour, of all components in the downstream section and the weekend/holiday components from 13 to 21 June had the highest chinook salmon harvest rate, 0.092 fish per hour, of all components in the upstream section (Table 7). Catch rates of chinook salmon peaked from 8 to 12 June in the downstream section and from 27 to 28 June in the upstream section (Figure 3).

Harvest and Catch. The estimated harvest of chinook salmon in Alexander Creek during the creel survey was 1,961 fish; 711 chinook salmon (36%) were harvested in the downstream section and 1,250 chinook salmon (64%) were harvested in the upstream section (Table 8). In the downstream section, 52% of the chinook salmon caught by anglers were released and, in the upstream section, 64% of the chinook salmon caught were released.

Table 4. Estimated harvest and catch rates[1] of chinook salmon during each of the weekday and weekend/holiday components of the fishery for chinook salmon in the Deshka River, 1987.

Location Component[2]		Number of Interviews[3]	Harvest Rate	Standard Error	Catch Rate	Standard Error
Downstream						
WE	5/23-5/25	286	0.0177	0.0041	0.0198	0.0042
WE	5/30-5/31	241	0.0174	0.0042	0.0205	0.0044
WE	6/06-6/07	498	0.0330	0.0034	0.0387	0.0042
WE	6/13-6/14	563	0.0805	0.0048	0.1109	0.0072
WE	6/20-6/21	94	0.0389	0.0070	0.0599	0.0119
WE	6/27-6/28	63	0.1133	0.0198	0.1484	0.0266
WD	5/26-5/29	52	0.0451	0.0184	0.0610	0.0186
WD	6/01-6/05	149	0.0537	0.0096	0.0892	0.0119
WD	6/08-6/12	345	0.1093	0.0087	0.1436	0.0188
WD	6/15-6/19	99	0.1062	0.0127	0.2529	0.0362
WD	6/22-6/26	151	0.0510	0.0073	0.0667	0.0093
WD	6/29-7/02	18	0.0333	0.0148	0.0333	0.0148
Upstream						
WE	5/23-5/25 5/30-5/31[4]	33	0.0040	0.0022	0.0040	0.0022
WE	6/06-6/07 6/13-6/14[4]	150	0.0485	0.0060	0.0643	0.0080
WE	6/20-6/21 6/27-6/28[4]	281	0.0603	0.0091	0.0874	0.0345
WE	7/03-7/05 7/11-7/12[4]	78	0.0909	0.0286	0.0992	0.0302
WD	5/26-5/29	0	0.0000	0.0000	0.0000	0.0000
WD	6/01-6/05	12	0.0482	0.0293	0.0482	0.0293
WD	6/08-6/12	68	0.0488	0.0109	0.0488	0.0109
WD	6/15-6/19	245	0.1022	0.0103	0.1399	0.0142
WD	6/22-6/26	84	0.1022	0.0149	0.1460	0.0259
WD	6/29-7/02	32	0.0878	0.0241	0.1419	0.0307
WD	7/06-7/10	21	0.0779	0.0187	0.0779	0.0187

[1] Harvest includes only fish kept and catch includes fish kept and fish reported as released. Rates are number of fish harvested or caught per hour fished for interviewed anglers.

[2] WE = weekend/holiday; WD = weekday.

[3] Completed-trip angler interviews only.

[4] Components were combined because of small sample sizes.

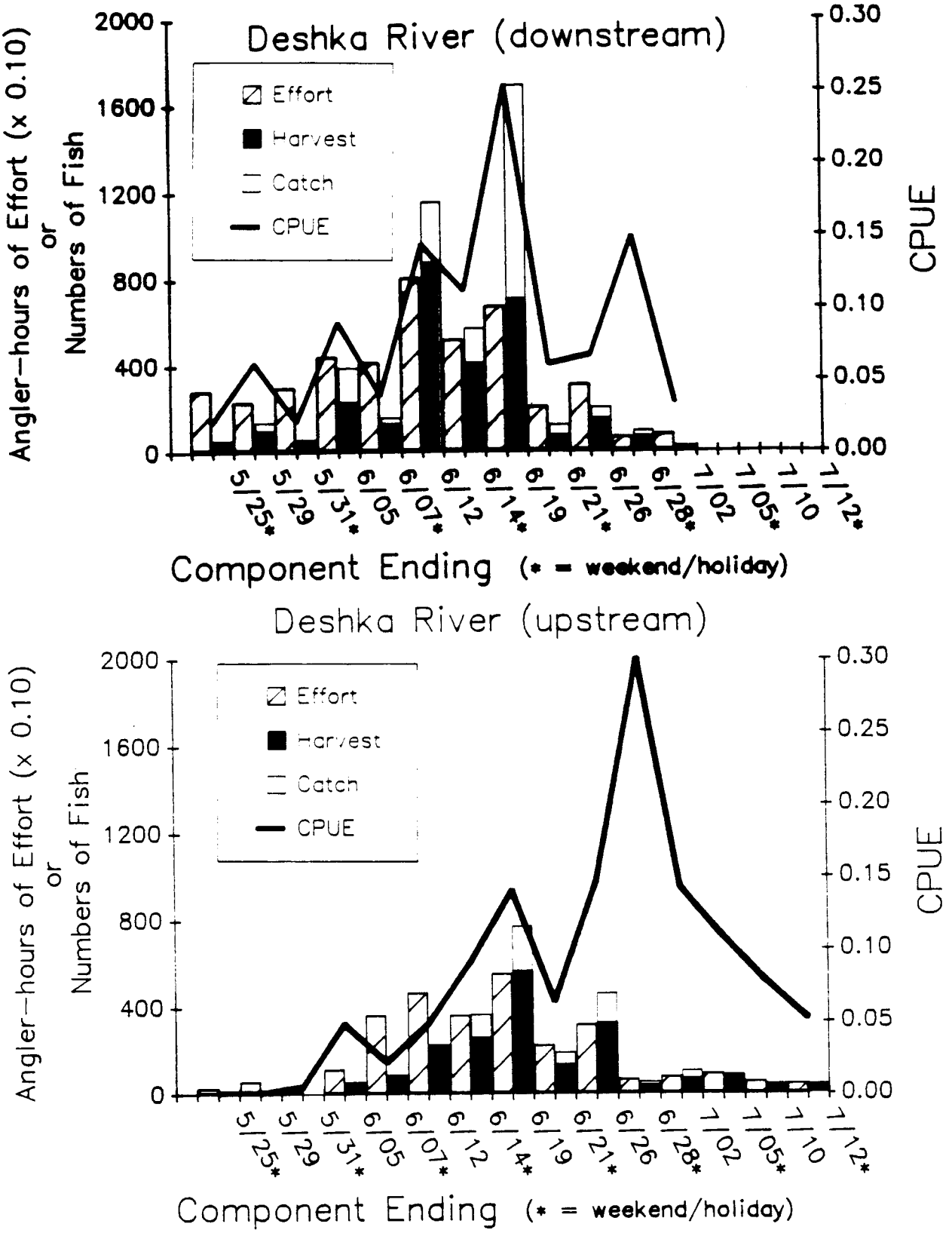

Figure 2. Angler-effort, chinook salmon harvest and catch, and catch per unit effort (CPUE) of chinook salmon for temporal components of the sport fishery in the downstream and upstream sections of the Deshka River, 1987.

Table 5. Estimated number of chinook salmon harvested[1] and number caught[2] during each of the weekday and weekend/holiday components of the fishery for chinook salmon in the Deshka River, 1987.

Location Component[3]		Harvest	SE[4]	95% Confidence Interval	Catch	SE[4]	95% Confidence Interval
Downstream							
WE	5/23-5/25	50	14.5	22 - 78	56	15.4	26 - 86
WE	5/30-5/31	52	14.5	24 - 80	61	15.8	30 - 92
WE	6/06-6/07	136	24.0	89 - 183	160	28.7	104 - 216
WE	6/13-6/14	416	61.1	296 - 536	573	85.3	406 - 740
WE	6/20-6/21	81	22.2	37 - 125	125	35.7	55 - 195
WE	6/27-6/28	75	19.3	37 - 113	98	25.5	48 - 148
	Sub-total	810	74.8	664 - 956	1,073	102.5	872 - 1,274
WD	5/26-5/29	104	45.0	16 - 192	140	48.0	68 - 212
WD	6/01-6/05	235	52.5	132 - 338	391	73.9	246 - 536
WD	6/08-6/12	880	116.4	652 - 1,108	1,156	193.9	776 - 1,536
WD	6/15-6/19	711	94.9	525 - 897	1,693	261.8	1,180 - 2,206
WD	6/22-6/26	158	31.4	96 - 220	206	40.5	127 - 285
WD	6/29-7/02	26	12.5	1 - 51	26	12.5	1 - 50
	Sub-total	2,114	168.7	1,783 - 2,445	3,612	340.1	2,945 - 4,279
TOTAL		2,924	184.5	2,562 - 3,286	4,685	355.2	3,989 - 5,381
Upstream							
WE	5/23-5/25, 5/30-5/31[5]	2	1.4	0 - 5	2	1.4	0 - 5
WE	6/06-6/07, 6/13-6/14[5]	348	64.3	222 - 474	462	85.4	295 - 629
WE	6/20-6/21, 6/27-6/28[5]	176	67.7	43 - 309	255	131.0	0 - 512
WE	7/03-7/05, 7/11-7/12[5]	128	56.6	17 - 239	139	60.8	20 - 258
	Sub-total	654	109.2	440 - 868	858	167.8	529 - 1,187
WD	5/26-5/29	0	0.0	--[6]	0	0.0	--[6]
WD	6/01-6/05	55	41.6	0 - 137	55	41.6	0 - 137
WD	6/08-6/12	228	62.1	106 - 350	228	62.1	106 - 350
WD	6/15-6/19	567	84.3	445 - 689	776	115.8	549 - 1,003
WD	6/22-6/26	328	118.1	97 - 559	469	174.5	342 - 1,026
WD	6/29-7/02	70	32.6	6 - 134	112	49.8	14 - 210
WD	7/06-7/10	44	28.2	0 - 99	44	28.2	0 - 99
	Sub-total	1,292	168.8	961 - 1,623	1,684	229.6	1,234 - 2,134
TOTAL		1,946	201.1	1,552 - 2,340	2,542	284.4	1,985 - 3,099
GRAND TOTAL		4,870	272.9	4,335 - 5,405	7,227	455.0	6,335 - 8,119

[1] Harvest includes only fish kept.

[2] Catch includes fish kept and fish reported as released.

[3] WE = weekend/holiday; WD = weekday.

[4] SE = standard error.

[5] Components were combined because of small sample sizes.

[6] Not possible to compute estimate.

Table 6. Estimated number of angler-hours of effort during each of the weekday and weekend/holiday components of the fishery for chinook salmon in Alexander Creek, 1987.

Location Component[1]		Effort	Standard Error	95% Confidence Interval	Relative Precision[2]
Downstream					
WE	5/23-5/25	753.0	122.1	514 - 992	31.8%
WE	5/30-5/31	870.0	202.5	473 - 1,267	45.6%
WE	6/06-6/07	1,398.0	353.0	706 - 2,090	49.5%
WE	6/13-6/14	1,386.0	201.3	991 - 1,781	28.5%
	Sub-total	4,407.0	470.2	3,486 - 5,329	20.9%
WD	5/26-5/29	748.0	133.7	486 - 1,010	35.0%
WD	6/01-6/05	1,507.5	234.3	1,048 - 1,967	30.5%
WD	6/08-6/12	2,932.5	360.2	2,227 - 3,638	24.1%
	Sub-total	5,188.0	450.0	4,306 - 6,070	17.0%
TOTAL		9,595.0	650.8	8,319 - 10,871	13.3%
Upstream					
WE	6/13-6/14 6/20-6/21[3]	3,078.0	1,175.9	733 - 5,383	74.9%
WE	6/27-6/28 7/03-7/05[3]	1,764.0	681.6	428 - 3,100	75.7%
WE	7/11-7/12	108.0	36.0	37 - 179	65.3%
	Sub-total	4,950.0	1,359.6	2,285 - 7,615	53.8%
WD	6/08-6/12	3,960.0	1,011.6	1,977 - 5,943	50.1%
WD	6/15-6/19	3,150.0	1,684.6	0 - 6,452	104.8%
WD	6/22-6/26	3,120.0	840.0	1,474 - 4,766	52.8%
WD	6/29-7/02	672.0	276.8	129 - 1,215	80.7%
WD	7/06-7/10	1,620.0	180.0	1,267 - 1,973	21.8%
	Sub-total	12,522.0	2,162.4	8,284 - 16,760	33.8%
TOTAL		17,472.0	2,554.3	12,465 - 22,478	28.7%
GRAND TOTAL		27,067.0	2,635.9	21,900 - 32,233	19.1%

[1] WE = weekend/holiday; WD = weekday.

[2] Relative precision of 95% confidence interval.

[3] Components were combined because of small sample sizes.

Table 7. Estimated harvest and catch rates[1] of chinook salmon during each of the weekday and weekend/holiday components of the fishery for chinook salmon in Alexander Creek, 1987.

Location Component[2]		Number of Interviews[3]	Harvest Rate	Standard Error	Catch Rate	Standard Error
Downstream						
WE	5/23-5/25	106	0.0239	0.0071	0.0239	0.0071
WE	5/30-5/31	22	0.0153	0.0081	0.0153	0.0081
WE	6/06-6/07	69	0.0879	0.0308	0.1942	0.0643
WE	6/13-6/14	84	0.0558	0.0086	0.0959	0.0142
WD	5/26-5/29	29	0.0881	0.0459	0.0881	0.0459
WD	6/01-6/05	76	0.0964	0.0138	0.1446	0.0182
WD	6/08-6/12	99	0.0916	0.0152	0.2574	0.0441
Upstream						
WE	6/13-6/14 6/20-6/21[4]	103	0.0924	0.0144	0.1617	0.0252
WE	6/27-6/28 7/03-7/05[4]	142	0.0702	0.0171	0.2137	0.0338
WE	7/11-7/12	12	0.0233	0.0156	0.3023	0.1020
WD	6/08-6/12	61	0.0834	0.0255	0.1669	0.0490
WD	6/15-6/19	171	0.0634	0.0093	0.2650	0.0277
WD	6/22-6/26	39	0.0670	0.0160	0.1818	0.0321
WD	6/29-7/02	35	0.0591	0.0228	0.0806	0.0301
WD	7/06-7/10	51	0.0372	0.0198	0.2851	0.0480

[1] Harvest includes only fish kept and catch includes fish kept and fish reported as released. Rates are number of fish harvested or caught per hour fished for interviewed anglers.

[2] WE = weekend/holiday; WD = weekday.

[3] Completed-trip angler interviews only.

[4] Components were combined because of small sample sizes.

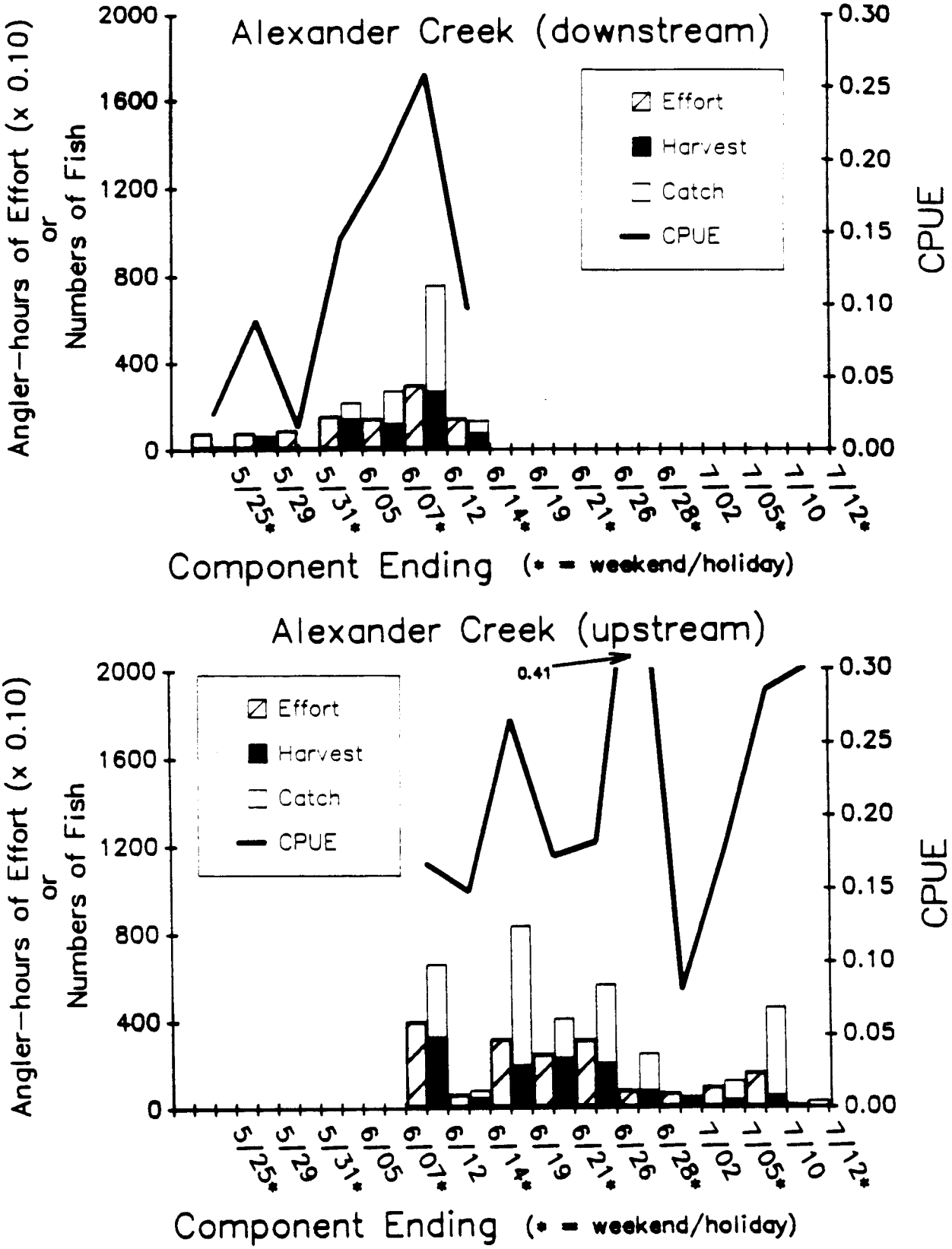

Figure 3. Angler-effort, chinook salmon harvest and catch, and catch per unit effort (CPUE) of chinook salmon for temporal components of the sport fishery in the downstream and upstream sections of Alexander Creek, 1987.

Table 8. Estimated number of chinook salmon harvested[1] and number caught[2] during each of the weekday and weekend/holiday components of the fishery for chinook salmon in Alexander Creek, 1987.

Location Component[3]		Harvest	SE[4]	95% Confidence Interval	Catch	SE[4]	95% Confidence Interval
Downstream							
WE	5/23-5/25	18	6.1	6 - 30	18	6.1	6 - 30
WE	5/30-5/31	13	7.5	0 - 28	13	7.5	0 - 28
WE	6/06-6/07	123	51.9	21 - 225	271	110.7	54 - 488
WE	6/13-6/14	77	16.3	45 - 109	133	27.4	79 - 187
	Sub-total	231	55.2	123 - 339	435	114.5	211 - 659
WD	5/26-5/29	66	35.8	0 - 136	66	35.8	0 - 136
WD	6/01-6/05	145	30.6	85 - 205	218	43.4	133 - 303
WD	6/08-6/12	269	55.2	161 - 377	755	158.4	445 - 1,065
	Sub-total	480	72.6	338 - 622	1,039	168.1	710 - 1,368
TOTAL		711	91.2	532 - 890	1,474	203.4	1,075 - 1,873
Upstream							
WE	6/13-6/14 6/20-6/21[5]	284	116.2	56 - 512	498	155.0	194 - 802
WE	6/27-6/28 7/03-7/05[5]	124	55.4	15 - 233	377	155.7	72 - 682
WE	7/11-7/12	3	1.8	0 - 7	33	15.0	4 - 62
	Sub-total	411	128.7	159 - 663	908	220.2	477 - 1,339
WD	6/08-6/12	330	129.1	77 - 583	661	252.4	166 - 1,156
WD	6/15-6/19	200	109.7	0 - 415	835	452.4	0 - 1,722
WD	6/22-6/26	209	74.1	64 - 354	567	180.6	213 - 921
WD	6/29-7/02	40	21.5	0 - 82	54	28.9	0 - 111
WD	7/06-7/10	60	32.6	0 - 124	462	92.7	280 - 644
	Sub-total	839	189.0	469 - 1,209	2,579	557.2	1,487 - 3,671
TOTAL		1,250	228.6	802 - 1,698	3,487	599.1	2,313 - 4,661
GRAND TOTAL		1,961	246.1	1,479 - 2,443	4,961	632.7	3,722 - 6,200

[1] Harvest includes only fish kept.

[2] Catch includes fish kept and fish reported as released.

[3] WE = weekend/holiday; WD = weekday.

[4] SE = standard error.

[5] Components were combined because of small sample sizes.

Lake Creek:

The creel survey of Lake Creek was conducted from 6 June through 12 July.

Effort. Anglers counts ranged from 0 to 170 (Appendix Table 8). Estimated angler-effort during the survey was 33,509 angler-hours, 12,744 angler-hours (38%) occurred during the weekend/holiday component and 20,765 angler-hours (62%) during the weekday component (Table 9).

Harvest Rates and Catch Rates. Daily harvest rates of chinook salmon ranged from 0.000 to 0.098 fish per hour and daily catch rates from 0.000 to 0.369 fish per hour (Appendix Table 9). The weekend/holiday component from 20 to 21 June has the highest chinook salmon harvest rate, 0.086 fish per hour, of all components in the fishery (Table 10). Catch rates of chinook salmon peaked from 22 to 26 June (Figure 4).

Harvest and Catch. The estimated harvest of chinook salmon in Lake Creek during the creel survey was 2,149 fish; 859 chinook salmon (40%) were harvested during the weekend/holiday component and 1,290 chinook salmon (60%) were harvested during the weekday component (Table 11). Anglers released 65% of the chinook salmon caught during the Lake Creek fishery.

Clear Creek (Talkeetna River) and Upper Susitna River:

A direct expansion creel survey was conducted at the Talkeetna boat landing from 13 June through 13 July to estimate angler-effort and chinook salmon harvest by the fisheries in Clear Creek and the Upper Susitna River.

Effort. The number of anglers exiting the fishery at Clear Creek through Talkeetna Landing during a surveyed period ranged from 0 to 344 (Appendix Table 10). Estimated angler-effort during the survey was 42,133 angler-hours, 22,762 angler-hours (54%) during the weekend/holiday component and 19,371 angler-hours (46%) during the weekday component (Table 12). The number of anglers exiting the fishery in the Upper Susitna River through Talkeetna Landing during a surveyed period ranged from 0 to 70 (Appendix Table 11). Only 7,637 angler-hours of effort were estimated for this fishery (Table 12).

Harvest Rates and Catch Rates. Daily harvest rates of chinook salmon ranged from 0.000 to 0.078 fish per hour (Appendix Table 12) for the Clear Creek fishery. The weekday component from 29 June to 2 July had the highest chinook salmon harvest rate, 0.066 fish per hour, of all components in the fishery (Table 13). Catch rates of chinook salmon peaked during the last week of the season at Clear Creek (Figure 5). Daily harvest rates of chinook salmon ranged from 0.000 to 0.250 fish per hour (Appendix Table 13) for the Upper Susitna River fishery. Peak harvest and catch rates of chinook salmon occurred during the month of June (Table 13).

Harvest and Catch. The estimated harvest of chinook salmon in Clear Creek during the creel survey was 1,930 fish; 799 chinook salmon (41%) were harvested during the weekend/holiday component and 1,131 chinook salmon (59%) were harvested during the weekday component (Table 14). During the fishery at Clear Creek, 46% of the chinook salmon caught by anglers were released. A

Table 9. Estimated number of angler-hours of effort during each of the weekday and weekend/holiday components of the fishery for chinook salmon in Lake Creek, 1987.

Component[1]		Effort	Standard Error	95% Confidence Interval	Relative Precision[2]
WE	6/06-6/07	124.0	104.1	0 - 328	164.5%
WE	6/13-6/14	2,232.0	323.0	1,599 - 2,865	28.4%
WE	6/20-6/21	3,644.0	344.4	2,969 - 4,319	18.5%
WE	6/27-6/28	3,352.0	214.3	2,347 - 4,357	12.5%
WE	7/03-7/05	2,884.0	203.2	2,486 - 3,282	13.8%
WE	7/11-7/12	508.0	66.3	378 - 638	25.6%
	Sub-total	12,744.0	570.4	11,626 - 13,862	8.8%
WD	6/08-6/12	1,380.0	306.0	780 - 1,980	43.5%
WD	6/15-6/19	4,686.7	351.8	3,997 - 5,376	14.7%
WD	6/22-6/26	8,260.0	512.6	7,255 - 9,265	12.2%
WD	6/29-7/02	4,613.3	408.2	3,813 - 5,413	17.3%
WD	7/06-7/10	1,825.0	247.2	1,340 - 2,310	26.5%
	Sub-total	20,765.0	841.4	19,116 - 22,414	7.9%
TOTAL		33,509.0	1,016.5	31,517 - 35,501	5.9%

[1] WE = weekend/holiday; WD = weekday.

[2] Relative precision of 95% confidence interval.

Table 10. Estimated harvest and catch rates[1] of chinook salmon during each of the weekday and weekend/holiday components of the fishery for chinook salmon in Lake Creek, 1987.

Component[2]	Number of Interviews[3]	Harvest Rate	Standard Error	Catch Rate	Standard Error
WE 6/06-6/07	63	0.0145	0.0078	0.0145	0.0078
WE 6/13-6/14	160	0.0459	0.0056	0.1338	0.0171
WE 6/20-6/21	224	0.0857	0.0072	0.2294	0.0195
WE 6/27-6/28	194	0.0757	0.0066	0.1862	0.0182
WE 7/03-7/05	288	0.0508	0.0049	0.1203	0.0148
WE 7/11-7/12	52	0.0822	0.0111	0.1756	0.0434
WD 6/08-6/12	153	0.0490	0.0101	0.1087	0.0472
WD 6/15-6/19	206	0.0621	0.0065	0.2083	0.0198
WD 6/22-6/26	310	0.0727	0.0053	0.2368	0.0315
WD 6/29-7/02	247	0.0439	0.0040	0.1179	0.0195
WD 7/06-7/10	155	0.0694	0.0087	0.1598	0.0227

[1] Harvest includes only fish kept and catch includes fish kept and fish reported as released. Rates are number of fish harvested or caught per hour fished for interviewed anglers.

[2] WE = weekend/holiday; WD = weekday.

[3] Completed-trip angler interviews only.

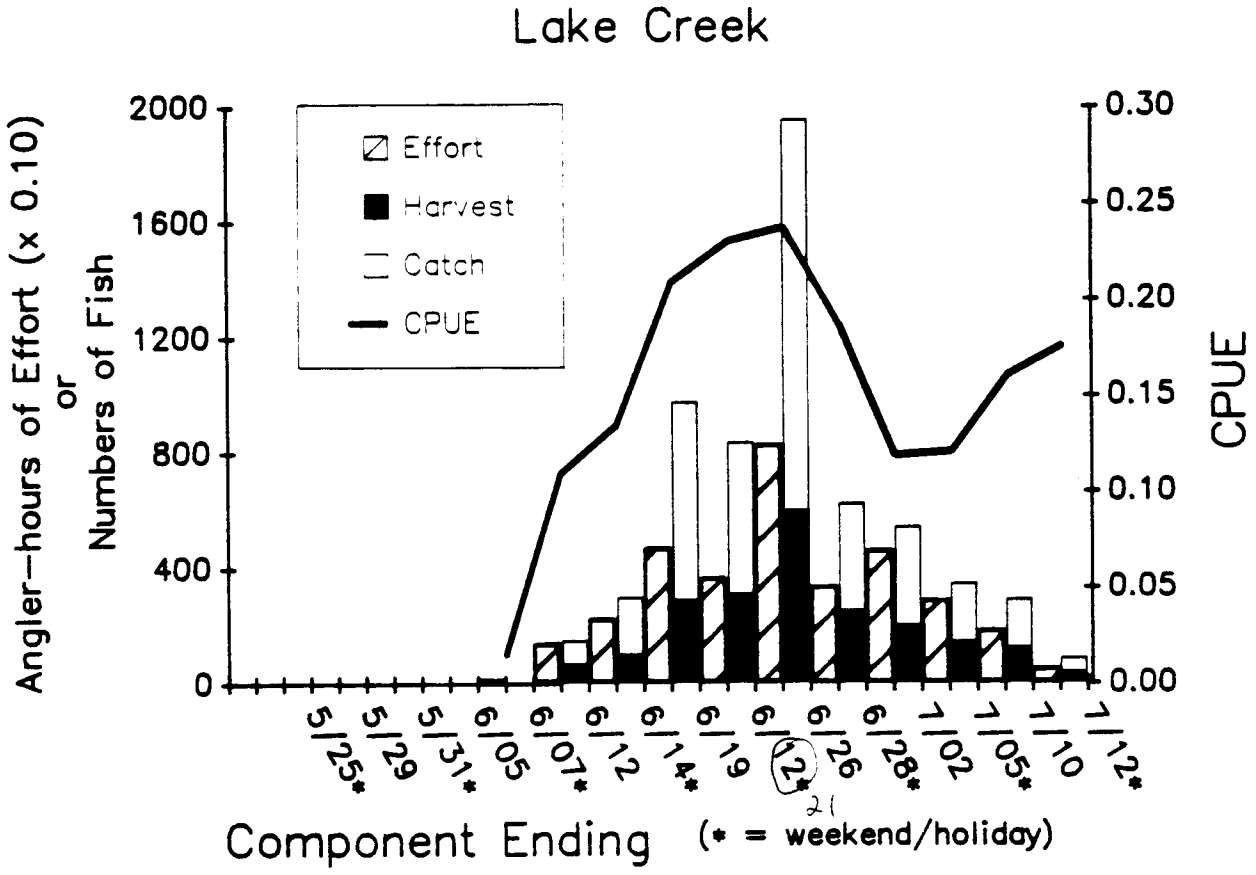

Figure 4. Angler-effort, chinook salmon harvest and catch, and catch per unit effort (CPUE) of chinook salmon for temporal components of the sport fishery in Lake Creek, 1987.

Table 11. Estimated number of chinook salmon harvested[1] and number caught[2] during each of the weekday and weekend/holiday components of the fishery for chinook salmon in Lake Creek, 1987.

Component[3]		Harvest	SE[4]	95% Confidence Interval	Catch	SE[4]	95% Confidence Interval
WE	6/06-6/07	2	1.6	0 - 5	2	1.6	0 - 5
WE	6/13-6/14	102	19.3	64 - 140	299	57.4	186 - 412
WE	6/20-6/21	312	39.4	235 - 389	836	105.9	628 - 1,044
WE	6/27-6/28	254	27.3	200 - 308	624	72.7	482 - 766
WE	7/03-7/05	147	17.4	113 - 181	347	49.0	251 - 443
WE	7/11-7/12	42	7.8	27 - 57	89	24.8	40 - 138
	Sub-total	859	55.1	750 - 967	2,197	151.0	1,901 - 2,493
WD	6/08-6/12	68	20.2	28 - 108	150	71.7	9 - 291
WD	6/15-6/19	291	37.3	218 - 364	976	118.1	745 - 1,207
WD	6/22-6/26	601	57.2	489 - 713	1,956	286.4	1,395 - 2,517
WD	6/29-7/02	203	25.5	153 - 253	544	101.6	345 - 743
WD	7/06-7/10	127	23.3	81 - 173	292	56.9	180 - 404
	Sub-total	1,290	79.1	1,134 - 1,445	3,918	338.6	3,254 - 4,582
TOTAL		2,149	96.5	1,960 - 2,338	6,115	370.8	5,388 - 6,842

[1] Harvest includes only fish kept.

[2] Catch includes fish kept and fish reported as released.

[3] WE = weekend/holiday; WD = weekday.

[4] SE = standard error.

Table 12. Estimated number of angler-hours of effort during each of the weekday and weekend/holiday components of the fisheries for chinook salmon in Clear Creek and the Upper Susitna River, 1987.

Fishery Component[1]		Effort	Standard Error	95% Confidence Interval	Relative Precision[2]
Clear Creek					
WE	6/13-6/14	117.7	85.8	0 - 286	142.9%
WE	6/20-6/21	1,210.3	40.7	1,131 - 1,290	6.6%
WE	6/27-6/28	3,968.0	1,858.3	326 - 7,610	91.8%
WE	7/03-7/06	13,249.2	3,508.3	6,373 - 20,125	51.9%
WE	7/11-7/12	4,217.2	784.1	2,680 - 5,754	36.4%
	Sub-total	22,762.4	4,047.9	14,829 - 30,696	34.9%
WD	6/15-6/19	274.3	235.6	0 - 736	168.3%
WD	6/22-6/26	2,118.3	994.6	169 - 4,068	92.0%
WD	6/29-7/02	6,688.7	1,380.3	3,983 - 9,394	40.4%
WD	7/06-7/10 7/13[3]	10,289.2	1,384.3	7,576 - 13,002	26.4%
	Sub-total	19,370.5	2,206.0	15,047 - 23,694	22.3%
TOTAL		42,132.9	4,609.9	33,097 - 51,168	21.4%
Upper Susitna River					
	6/13-6/30[3]	5,071.1	1,650.0	1,837 - 8,305	63.8%
	7/01-7/05[3]	1,007.8	297.9	424 - 1,592	57.9%
	7/06-7/13[3]	1,558.1	506.8	565 - 2,551	63.8%
TOTAL		7,637.0	1,751.6	4,204 - 11,070	45.0%

[1] WE = weekend/holiday.

[2] Relative precision of 95% confidence interval.

[3] Components were combined because of small sample sizes.

Table 13. Estimated harvest and catch rates[1] of chinook salmon during each of the weekday and weekend/holiday components of the fishery for chinook salmon in Clear Creek and the Upper Susitna River, 1987.

Location Component[2]	Number of Interviews[3]	Harvest Rate	Standard Error	Catch Rate	Standard Error
Clear Creek					
WE 6/13-6/14	12	0.0000	0.0000	0.0000	0.0000
WE 6/20-6/21	85	0.0208	0.0060	0.0397	0.0131
WE 6/27-6/28	257	0.0280	0.0047	0.0369	0.0062
WE 7/03-7/05	793	0.0306	0.0023	0.0504	0.0043
WE 7/11-7/12	318	0.0619	0.0051	0.1550	0.0188
WD 6/15-6/19	14	0.0000	0.0000	0.0000	0.0000
WD 6/22-6/26	107	0.0367	0.0072	0.0367	0.0072
WD 6/29-7/02	243	0.0660	0.0083	0.0782	0.0109
WD 7/06-7/10 7/13[4]	394	0.0578	0.0052	0.1427	0.0290
Upper Susitna River					
6/13-6/30[4]	224	0.0780	0.0154	0.0951	0.0264
7/01-7/05[4]	95	0.0372	0.0181	0.0398	0.0183
7/06-7/13[4]	83	0.0372	0.0175	0.0645	0.0246

[1] Harvest includes only fish kept and catch includes fish kept and fish reported as released. Rates are number of fish harvested or caught per hour fished for interviewed anglers.

[2] WE = weekend/holiday; WD = weekday.

[3] Completed-trip angler interviews only.

[4] Components were combined because of small sample sizes.

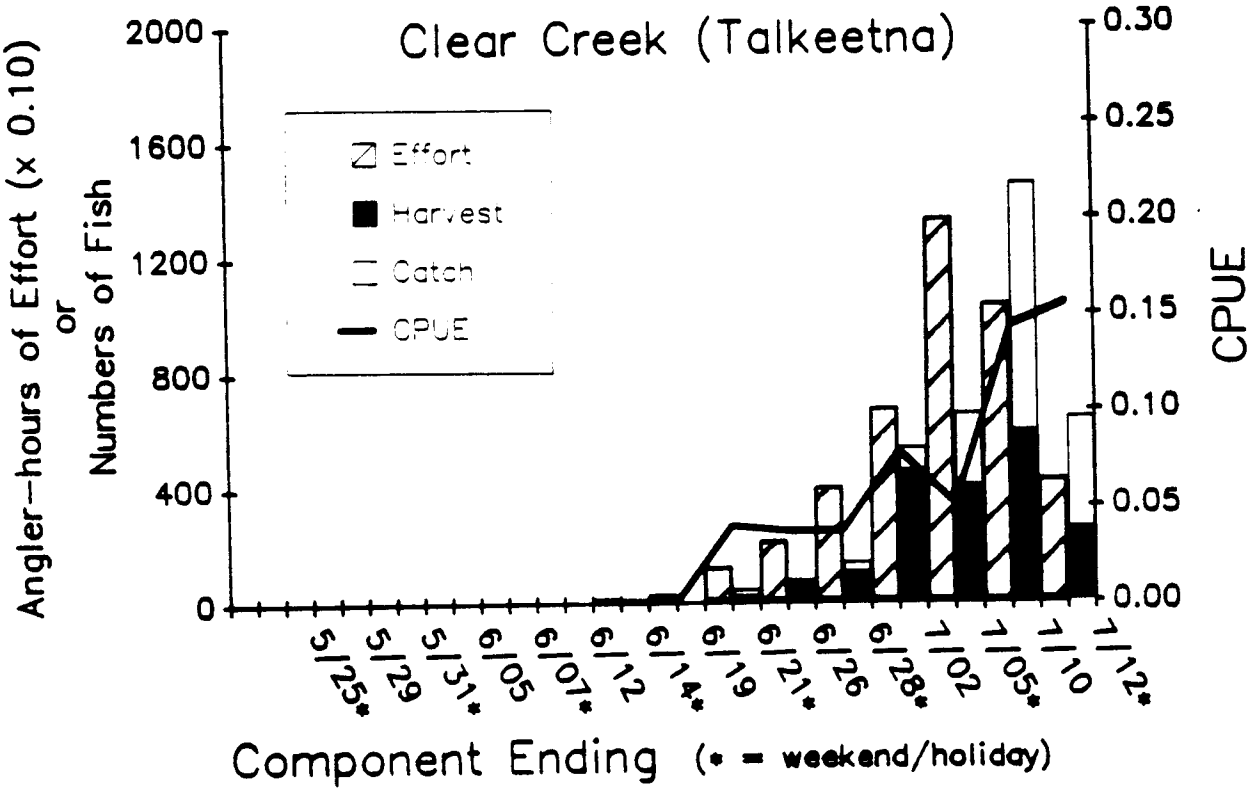

Figure 5. Angler-effort, chinook salmon harvest and catch, and catch per unit effort (CPUE) of chinook salmon for temporal components of the sport fishery in Clear Creek, 1987.

Table 14. Estimated number of chinook salmon harvested[1] and number caught[2] during each of the weekday and weekend/holiday components of the fisheries for chinook salmon in Clear Creek and the Upper Susitna River, 1987.

Fishery Component[3]		Harvest	SE[4]	95% Confidence Interval	Catch	SE[4]	95% Confidence Interval
Clear Creek							
WE	6/13-6/14	0	0.0	--[5]	0	0.0	--[5]
WE	6/20-6/21	25	3.8	18 - 32	48	13.8	21 - 75
WE	6/27-6/28	108	40.2	29 - 188	142	56.8	31 - 253
WE	7/03-7/06	407	88.1	234 - 580	656	193.1	278 - 1,035
WE	7/11-7/12	259	40.2	180 - 338	642	94.9	456 - 828
	Sub-total	799	104.9	593 - 1,005	1,488	223.0	1,051 - 1,925
WD	6/15-6/19	0	0.0	--[5]	0	0.0	--[5]
WD	6/22-6/26	78	45.0	0 - 166	78	45.0	0 - 166
WD	6/29-7/02	459	66.0	330 - 588	539	94.8	353 - 725
WD	7/06-7/10 7/13[6]	594	64.2	468 - 720	1,451	404.6	658 - 2,244
	Sub-total	1,131	102.5	930 - 1,332	2,068	418.0	1,249 - 2,887
TOTAL		1,930	146.7	1,643 - 2,217	3,556	473.7	2,627 - 4,485
Upper Susitna River							
	6/13-6/30[6]	393	153.9	91 - 695	478	185.1	115 - 841
	7/01-7/05[6]	33	10.8	12 - 54	36	12.3	12 - 60
	7/06-7/13[6]	58	23.0	13 - 149	100	31.7	38 - 149
TOTAL		484	156.0	178 - 790	614	188.2	245 - 983

[1] Harvest includes only fish kept.

[2] Catch includes fish kept and fish reported as released.

[3] WE = weekend/holiday; WD = weekday.

[4] SE = standard error.

[5] Not possible to compute estimate.

[6] Components were combined because of small sample sizes.

harvest of only 484 chinook salmon was estimated for the fishery in the Upper Susitna River; 81% of the harvest occurred during June (Table 14). Anglers released 21% of their chinook salmon catch during the Upper Susitna River fishery.

Roadside Streams

The roadside streams are those which are accessible to anglers from the road system. In 1987, creel surveys were conducted in the following roadside streams: Willow, Little Willow, Sheep, Goose, and Montana Creeks and the Little Susitna River. Direct expansion creel surveys were used at all these locations. The fisheries in all roadside streams except the Little Susitna River are weekend-only fisheries (from midnight Friday to midnight Monday). The fishery in the Little Susitna River is open 7 days a week.

Willow Creek:

Direct expansion creel surveys were conducted at the stream mouth and the Parks Highway bridge locations on Willow Creek during the 3 weekends from 20 June to 6 July. Anglers fishing at Willow Creek also exited the fishery at Susitna Landing during the 4 weekends from 13 June to 6 July.

Effort. The number of anglers exiting the fishery at Willow Creek through Susitna Landing during a surveyed period ranged from 0 to 22 (Appendix Table 14). Most anglers exited the fishery at the mouth, where the number of anglers exiting the fishery during a surveyed period ranged from 13 to 76 (Appendix Table 15), or at the Parks Highway bridge, where the number of anglers exiting the fishery ranged from 0 to 88 (Appendix Table 16). Estimated angler-effort during the survey was 17,721 angler-hours (Table 15). Most of the effort exited the fishery at the mouth (55% of the total) or Parks Highway bridge (35% of the total); only 10% of the effort exited the fishery through Susitna Landing.

Harvest Rates and Catch Rates. The highest chinook salmon harvest rate (0.105 fish per hour) for the Willow Creek fishery occurred during the weekend from 27 June to 29 July (Table 16). Catch rates of chinook salmon peaked during the last 2 weeks of the season (Figure 6).

Harvest and Catch. The estimated harvest of chinook salmon in Willow Creek during the creel survey was 1,732 fish (Table 17). Most of the harvest occurred during the last 2 weekends the fishery was open (Figure 6). During the Willow Creek fishery, 58% of the chinook salmon caught by anglers were released.

Little Willow Creek:

A direct expansion creel survey was conducted at the Parks Highway bridge on Little Willow Creek during the 2 weekends from 27 June to 6 July. Anglers fishing at Little Willow Creek also exited the fishery at Susitna Landing during the 4 weekends from 13 June to 6 July and at the boat landing at Willow Creek bridge during the 3 weekends from 20 June to 6 July.

Table 15. Estimated number of angler-hours of effort during the weekend-only fisheries for chinook salmon in Willow and Little Willow creeks, 1987.

Fishery - Location Component[1]		Effort	Standard Error	95% Confidence Interval	Relative Precision[2]
Willow Creek - Susitna Landing					
WE	6/13-6/15	105.0	67.4	0 - 237	125.8%
WE	6/20-6/22	457.0	144.8	173 - 741	62.1%
WE	6/27-6/29	777.0	77.8	625 - 929	19.6%
WE	7/04-7/06	426.0	149.2	134 - 718	68.6%
	Sub-total	1,765.0	232.0	1,310 - 2,220	25.8%
Willow Creek - Mouth					
WE	6/20-6/22	2,346.5	241.4	1,873 - 2,820	20.2%
WE	6/27-6/29	4,182.5	402.3	3,394 - 4,971	18.9%
WE	7/04-7/06	3,186.0	313.3	2,572 - 3,800	19.3%
	Sub-total	9,715.0	564.2	8,609 - 10,821	11.4%
Willow Creek - Bridge					
WE	6/20-6/22	1,604.6	198.7	1,215 - 1,994	24.3%
WE	6/27-6/29	1,872.1	369.3	1,148 - 2,596	38.7%
WE	7/04-7/06	2,763.9	471.4	1,840 - 3,688	33.4%
	Sub-total	6,240.6	630.9	5,004 - 7,477	19.8%
TOTAL		17,720.6	877.6	16,001 - 19,441	9.7%
Little Willow Creek - Susitna Landing					
WE	6/13-6/15	18.0	14.7	0 - 47	160.1%
WE	6/20-6/22	414.0	135.3	149 - 679	64.1%
WE	6/27-6/29	861.0	546.3	0 - 1,932	124.4%
WE	7/04-7/06	111.0	58.2	3 - 225	102.8%
	Sub-total	1,404.0	566.0	295 - 2,513	79.0%
Little Willow Creek - Willow Creek Bridge Landing					
WE	6/20-6/22 6/27-6/29 7/04-7/06[3]	502.0	165.4	178 - 826	64.6%
Little Willow Creek - Bridge					
WE	6/27-6/29 7/04-7/06[3]	3,825.8	747.3	2,361 - 5,291	38.3%
TOTAL		5,731.8	951.9	3,866 - 7,598	32.6%

[1] WE = weekend/holiday.

[2] Relative precision of 95% confidence interval.

[3] Components were combined because of small sample sizes.

Table 16. Estimated harvest and catch rates[1] of chinook salmon during the weekend-only fisheries for chinook salmon in Willow and Little Willow creeks, 1987.

Location Component[2]	Number of Interviews[3]	Harvest Rate	Standard Error	Catch Rate	Standard Error
Willow Creek					
WE 6/13-6/15	7	0.0571	0.0192	0.0571	0.0192
WE 6/20-6/22	491	0.0807	0.0058	0.1574	0.0120
WE 6/27-6/29	618	0.1054	0.0048	0.2580	0.0154
WE 7/04-7/06	598	0.0942	0.0051	0.2427	0.0152
Little Willow Creek					
WE 6/13-6/15	3	0.0000	0.0000	0.0000	0.0000
WE 6/20-6/22	65	0.1250	0.0241	0.2270	0.0487
WE 6/27-6/29	164	0.1283	0.0128	0.1796	0.0238
WE 7/04-7/06	77	0.0731	0.0126	0.1865	0.0460

[1] Harvest includes only fish kept and catch includes fish kept and fish reported as released. Rates are number of fish harvested or caught per hour fished for interviewed anglers.

[2] WE = weekend/holiday; WD = weekday.

[3] Completed-trip angler interviews only.

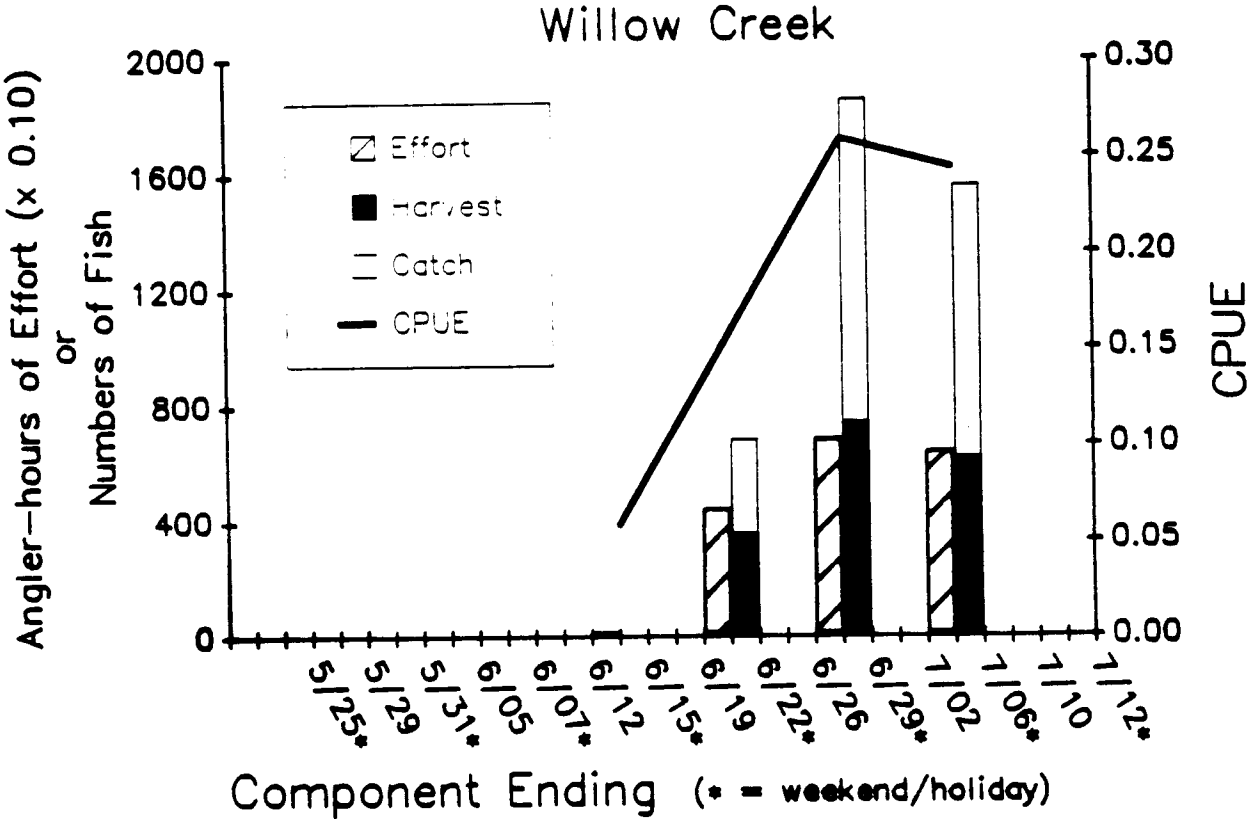

Figure 6. Angler-effort, chinook salmon harvest and catch, and catch per unit effort (CPUE) of chinook salmon for temporal components of the sport fishery in Willow Creek, 1987.

Table 17. Estimated number of chinook salmon harvested[1] and number caught[2] during the weekend-only fisheries for chinook salmon in Willow and Little Willow creeks, 1987.

Location Component[3]		Harvest	SE[4]	95% Confidence Interval	Catch	SE[4]	95% Confidence Interval
Willow Creek - Susitna Landing							
WE	6/13-6/15	6	4.9	0 - 16	6	4.9	0 - 16
WE	6/20-6/22	53	28.0	0 - 108	125	78.2	0 - 278
WE	6/27-6/29	105	37.4	32 - 178	174	27.5	120 - 228
WE	7/04-7/06	62	12.6	37 - 87	104	14.8	75 - 133
	Sub-total	226	48.6	131 - 321	409	84.3	244 - 574
Willow Creek - Mouth							
WE	6/20-6/22	162	21.4	120 - 204	372	64.6	245 - 499
WE	6/27-6/29	356	43.8	270 - 442	1,149	205.2	747 - 1,551
WE	7/04-7/06	264	21.8	221 - 307	768	132.4	508 - 1,028
	Sub-total	782	53.4	677 - 887	2,289	252.6	1,794 - 2,784
Willow Creek - Bridge							
WE	6/20-6/22	144	23.6	98 - 190	188	21.9	145 - 231
WE	6/27-6/29	284	43.3	199 - 369	538	108.7	325 - 751
WE	7/04-7/06	296	61.8	175 - 417	692	192.2	315 - 1,069
	Sub-total	724	79.1	569 - 879	1,418	221.9	983 - 1,853
TOTAL		1,732	107.1	1,522 - 1,942	4,116	346.6	3,437 - 4,795
Little Willow Creek - Susitna Landing							
WE	6/13-6/15	0	0.0	0 - 0	0	0.0	0 - 0
WE	6/20-6/22	34	10.2	14 - 54	85	22.4	41 - 129
WE	6/27-6/29	114	69.3	0 - 250	204	89.9	28 - 380
WE	7/04-7/06	18	12.5	0 - 43	114	90.7	0 - 292
	Sub-total	166	71.2	27 - 305	403	129.7	149 - 657
Little Willow Creek - Willow Creek Bridge Landing							
WE	6/20-6/22 6/27-6/29 7/04-7/06[5]	86	37.6	12 - 160	102	46.1	12 - 192
Little Willow Creek - Bridge							
WE	6/27-6/29 7/04-7/06[5]	346	94.6	161 - 531	457	82.0	296 - 618
TOTAL		598	124.3	354 - 842	962	160.2	648 - 1,276

[1] Harvest includes only fish kept.

[2] Catch includes fish kept and fish reported as released.

[3] WE = weekend/holiday.

[4] SE = standard error.

[5] Components were combined because of small sample sizes.

Effort. Most anglers exited the fishery at Little Willow Creek at the Parks Highway bridge, where the number of anglers exiting the fishery during a surveyed period ranged from 3 to 39 (Appendix Table 18), or at Susitna Landing, where the number of anglers exiting the fishery ranged from 0 to 40 (Appendix Table 19). The number of anglers exiting the fishery at the Willow Creek boat landing during a surveyed period ranged from 0 to 22 (Appendix Table 19). Estimated angler-effort during the survey was 5,732 angler-hours (Table 15). The majority of the effort exited the fishery at the Parks Highway bridge (67% of the total) or Susitna Landing (24% of the total); only 9% of the effort exited the fishery at the Willow Creek boat landing.

Harvest Rates and Catch Rates. The highest chinook salmon harvest rate (0.128 fish per hour) for the Little Willow Creek fishery occurred during the weekend from 27 June to 29 June (Table 16).

Harvest and Catch. The estimated harvest of chinook salmon in Little Willow Creek during the creel survey was 598 fish (Table 17). During the Little Willow Creek fishery, 38% of the chinook salmon caught by anglers were released.

Sheep Creek:

A direct expansion creel survey was conducted at the Parks Highway bridge on Sheep Creek during the 4 weekends from 13 June to 6 July.

Effort. The number of anglers exiting the fishery at Sheep Creek during a surveyed period ranged from 0 to 114 (Appendix Table 20). Estimated angler-effort during the survey was 16,054 angler-hours (Table 18). Most of the effort (66% of the total) occurred during the last 2 weekends of the fishery (Figure 7).

Harvest Rates and Catch Rates. The highest chinook salmon harvest rate (0.084 fish per hour) for the Sheep Creek fishery occurred during the weekend from 27 June to 29 June (Table 19). Catch rates of chinook salmon peaked during the second week of the season, 20 June through 22 June (Figure 7).

Harvest and Catch. The estimated harvest of chinook salmon in Sheep Creek during the creel survey was 1,077 fish (Table 20). Most of the harvest occurred during the last 2 weekends the fishery was open (Figure 7). Only 19% of the chinook salmon caught by anglers were released during the Sheep Creek fishery.

Goose Creek:

A direct expansion creel survey was conducted at the Parks Highway bridge on Goose Creek during the 2 weekends from 27 June to 6 July.

Effort. The number of anglers exiting the fishery at Goose Creek during a surveyed period ranged from 0 to 32 (Appendix Table 21). Estimated angler-effort during the survey was 2,705 angler-hours (Table 18).

Table 18. Estimated number of angler-hours of effort during the weekend-only fisheries for chinook salmon in Sheep, Goose, and Montana creeks, 1987.

Fishery Component[1]	Effort	Standard Error	95% Confidence Interval	Relative Precision[2]
Sheep Creek				
WE 6/13-6/15	2,745.5	407.4	1,947 - 3,544	29.1%
WE 6/20-6/22	2,791.6	200.8	2,398 - 3,185	14.1%
WE 6/27-6/29	5,262.8	410.5	4,458 - 6,067	15.3%
WE 7/04-7/06	5,254.5	606.9	4,065 - 6,444	22.6%
TOTAL	16,054.4	862.1	14,365 - 17,744	10.5%
Goose Creek				
WE 6/27-6/29 7/04-7/06[3]	2,705.1	1,894.8	0 - 6,419	137.3%
Montana				
WE 6/20-6/22	1,827.0	247.2	1,342 - 2,312	26.5%
WE 6/27-6/29	5,666.2	540.9	4,606 - 6,726	18.7%
WE 7/04-7/06	9,056.3	1,186.9	6,730 - 11,383	25.7%
TOTAL	16,549.5	1,327.6	13,947 - 19,152	15.7%

[1] WE = weekend/holiday.

[2] Relative precision of 95% confidence interval.

[3] Components were combined because of small sample sizes.